Soil Vapor Extraction (SVE)

General Principles and Site Applications

Former Marine Corps Air Station El Toro

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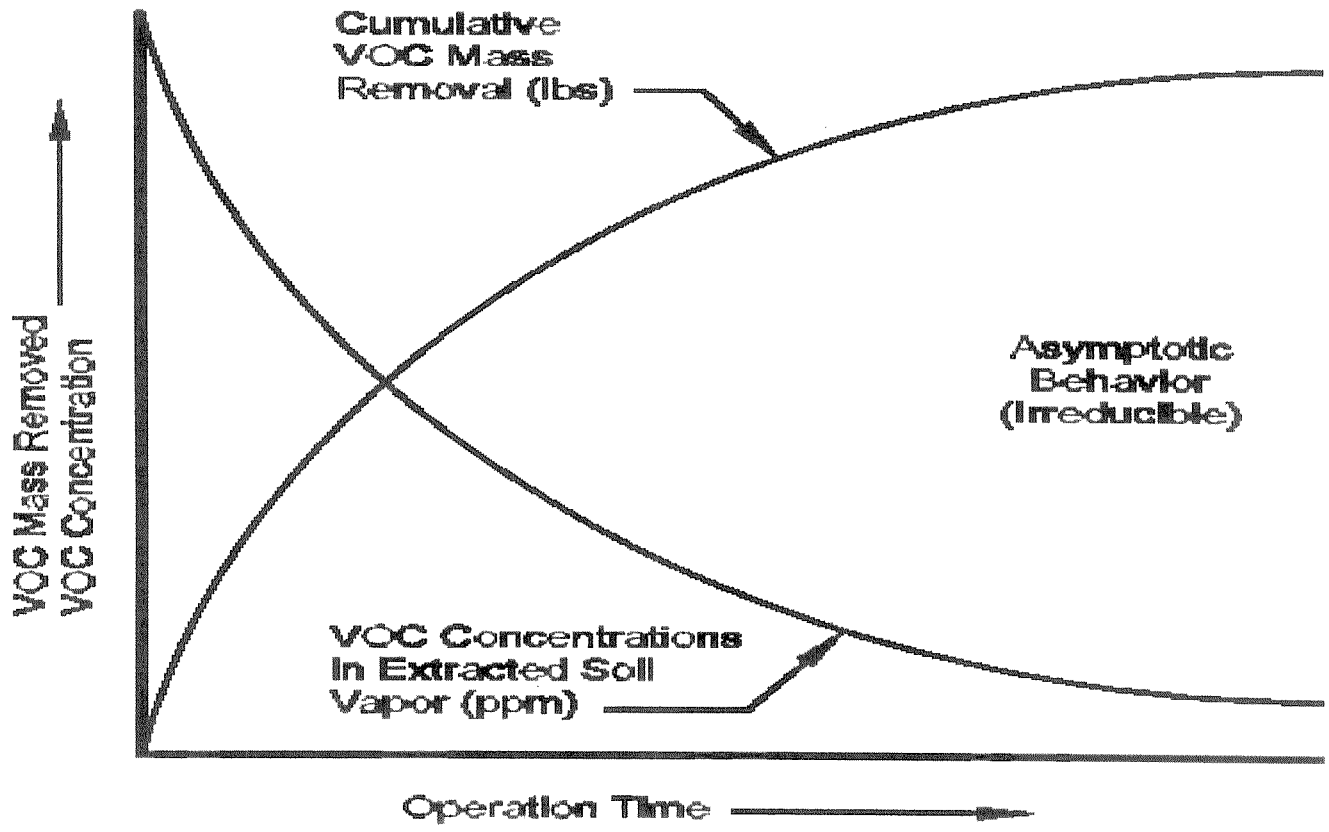
SVE Life Cycle

- Pilot Test
  - Install pilot wells (screen, spacing, layout, soil sampling)
  - Conduct "Step Test" to obtain vacuum-flow response data
  - Conduct "Constant Rate Tests" to measure flows and induced pressure gradients at various applied vacuums
  - Collect soil vapor samples for laboratory analysis
- Design
  - Use pressure response measurements to estimate vacuum radius of influence
  - Use flow, porosity, moisture content, bulk density, temperature, vacuum radius of influence, etc. to estimate soil permeability and effective radius of influence (based on critical flow velocity)
  - Determine number and layout of extraction and monitoring wells
  - Use Step Test data to size blower, flow data to size pipes, soil vapor data to select air pollution control technology
- Construction and Startup
- Operation and Maintenance (O&M) and Shutdown
  - Field logs; utilities; well balancing; asymptote; rebound; cost

Remedial Progress Monitoring

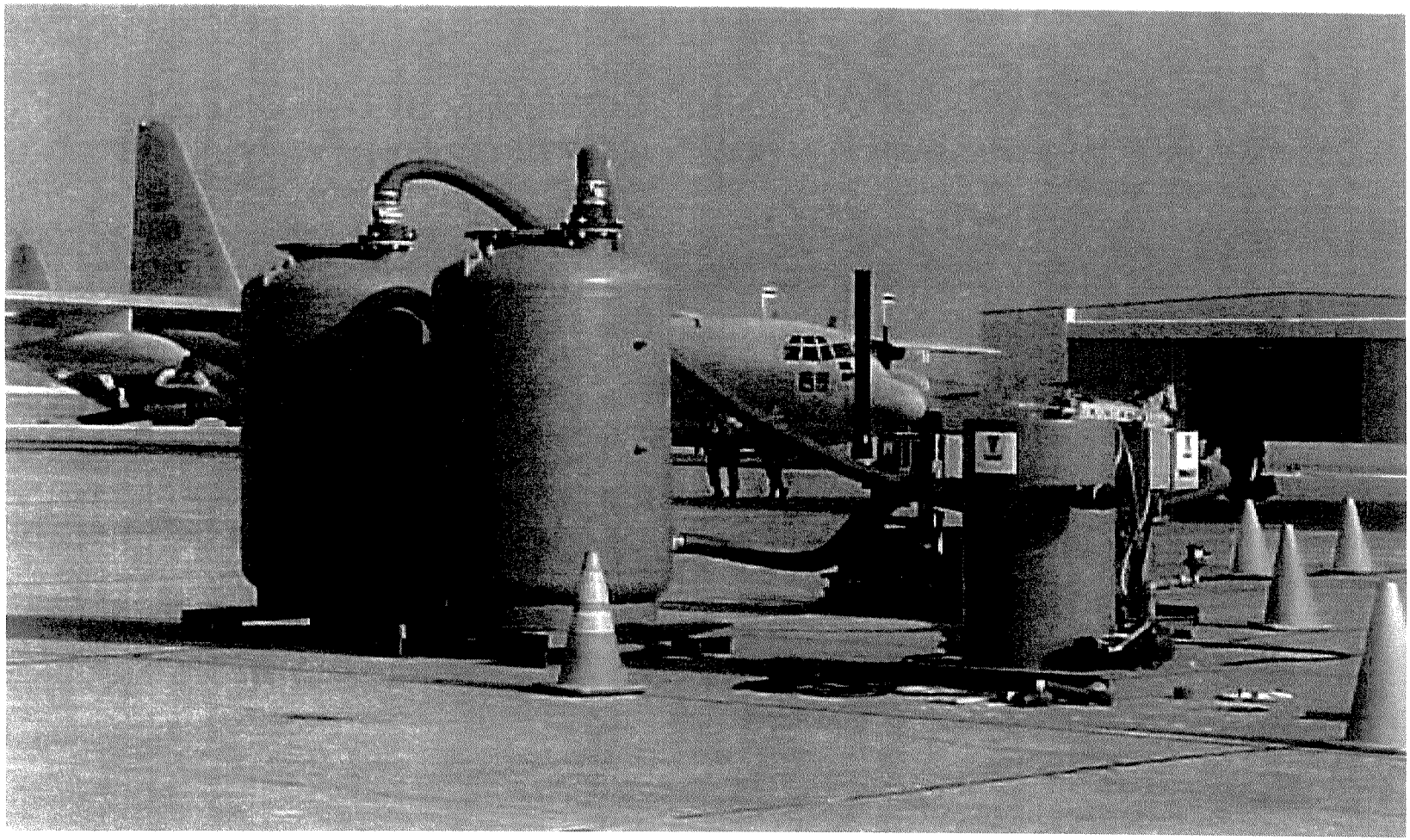
Exhibit II-18
Relationship Between Concentration Reduction And Mass Removal



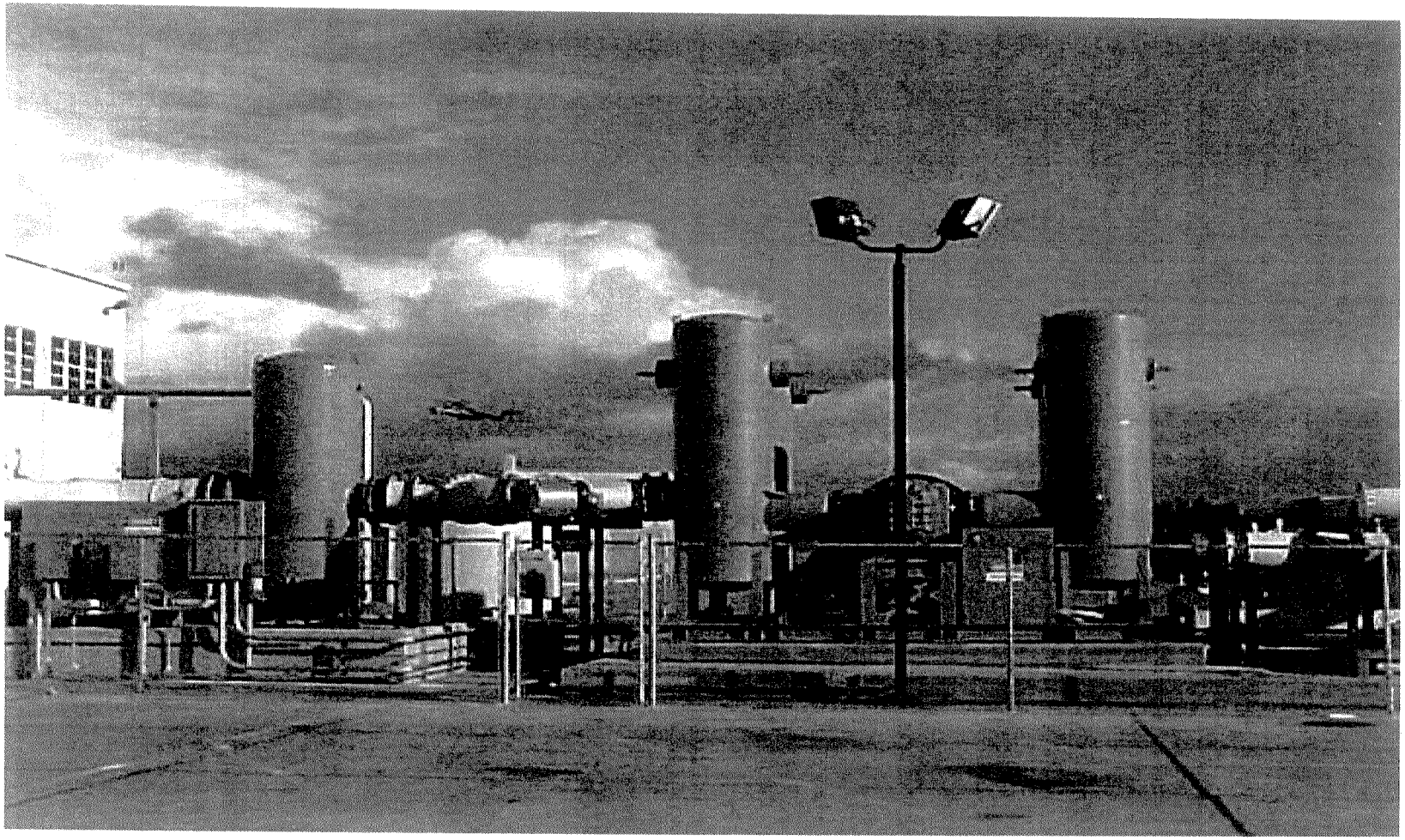
Previous SVE Use at MCAS El Toro

- SVE tests have been conducted previously at two UST sites to evaluate the removal gasoline contamination from the soil.
- SVE test were also conducted at three UST sites to evaluate the removal of heating oil contamination from the soil.
- SVE successfully remediated VOC concentrations at Site 24 and a Proposed Plan is currently being prepared to propose that no further action is necessary for the soil.
- SVE systems generally "off-the-shelf" and can easily be modified to meet site-specific conditions.

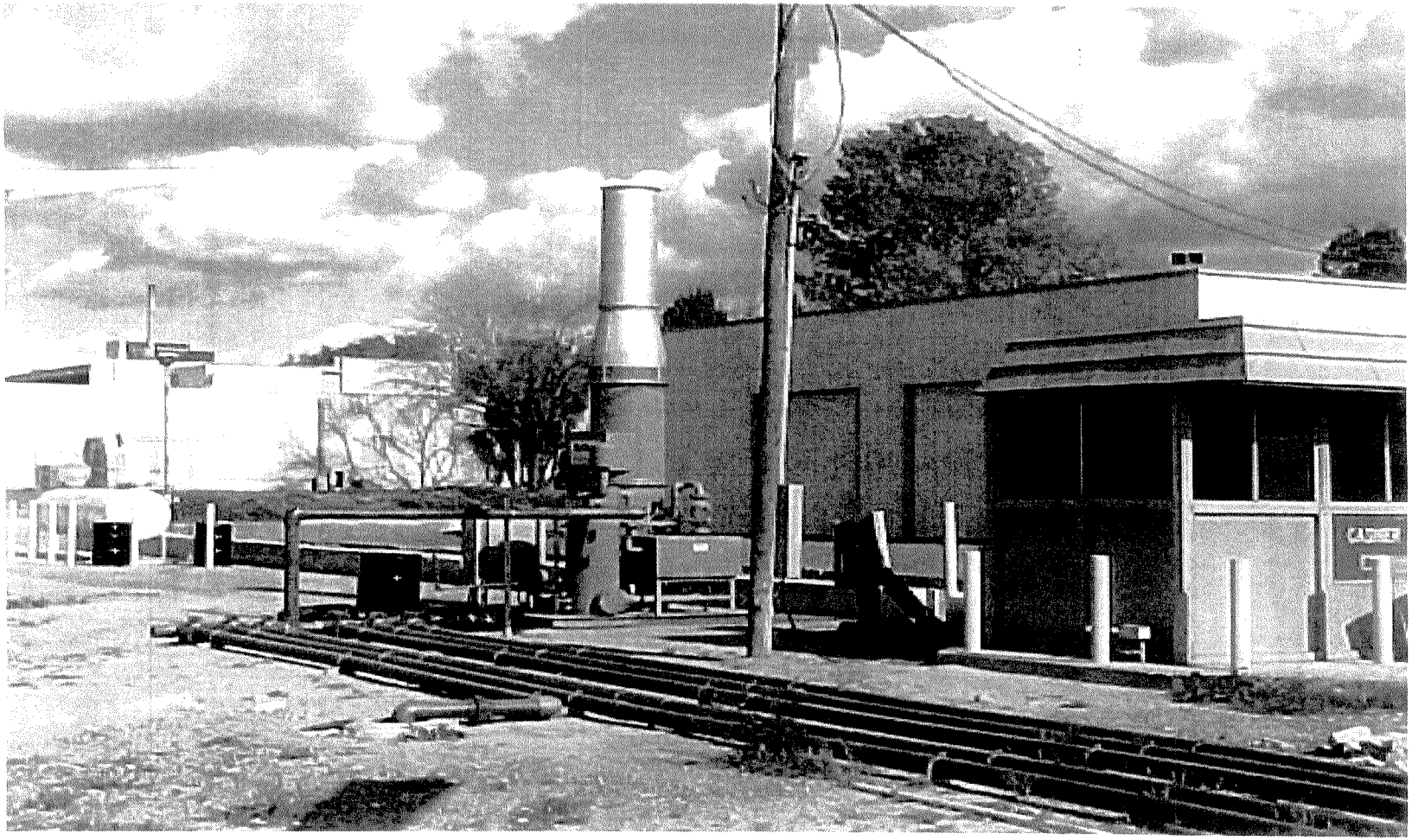
Portable SVE System at Site 24



SVE System at Site 24

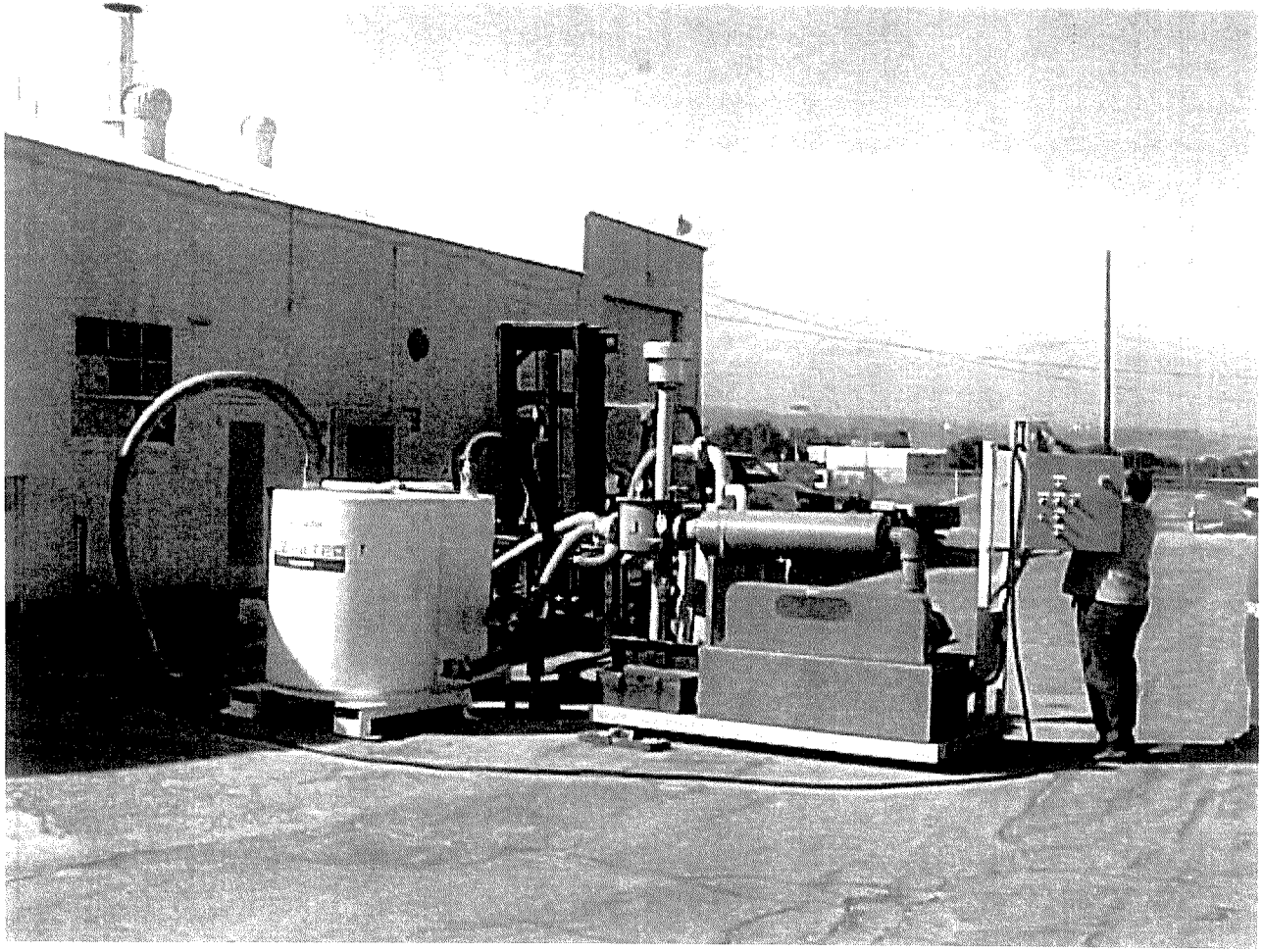


SVE System at Former UST 651 Site



SVE System at Former UST 1B Site

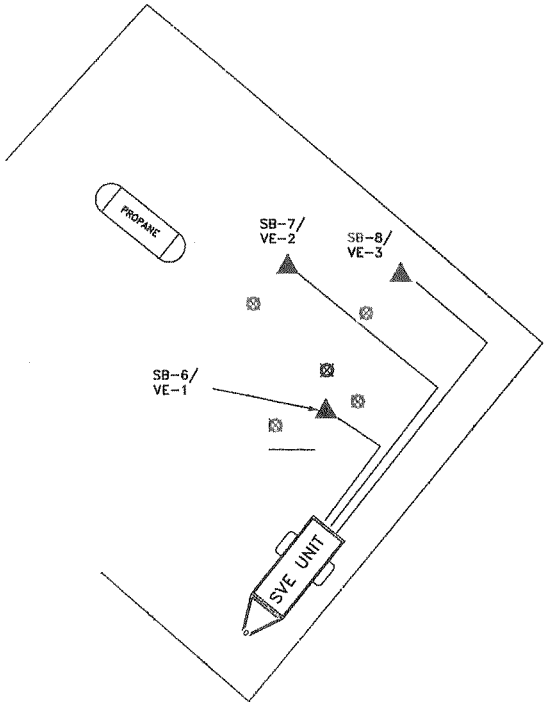
SVE System at Former UST 390 Site



Future SVE Tests at MCAS El Toro

- Planning to conduct two additional SVE tests in the Summer of 2005 at Site 16 and UST 273B.
- Site 16 consists of both total petroleum hydrocarbon and VOC contamination in the soil from fire-fighter training activities.
- UST 273B contains heating oil contamination to approximately 60 feet below ground surface.
- Results from the SVE tests at these two sites will assist in evaluating the use of SVE at other sites with similar contaminants and soil conditions.

Plan View – UST 273B



LEGEND

- ⊠ = 2004 SOIL BORING LOCATION
- ------- = UST 273B EXCAVATION
- ▲ SB-8/VE-3 = PROPOSED SOIL BORING/VAPOR EXTRACTION WELL LOCATION
- SVE = SOIL VAPOR EXTRACTION

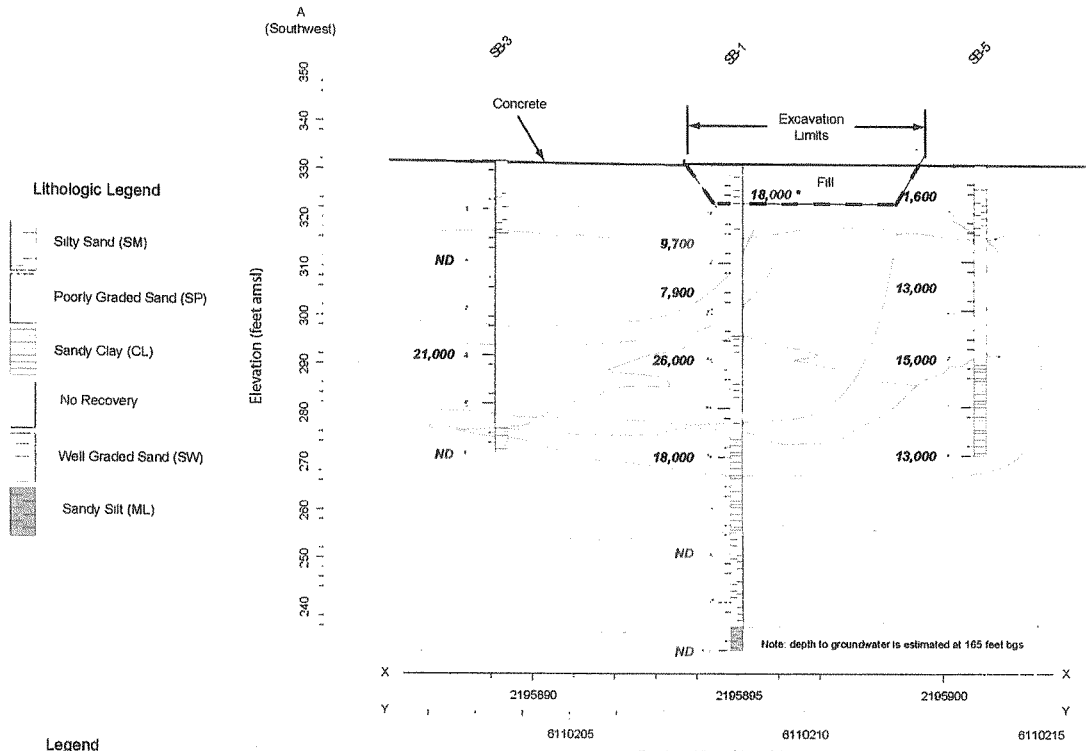
GRAPHIC SCALE

DATE: 05/2005

FIGURE 4-3
CONCEPTUAL SVE PROPOSED LOCATIONS

Site Assessment at Former UST 273B
Former MCAS El Toro, California

Cross-Section – UST-273B



Legend

18,000 = Diesel Fuel Concentration in Soil Sample (mg/kg)
mg/kg = milligrams per kilogram
bgs = below ground surface
ND = not detected
amsl = above mean sea level
* grab sample collectected from the UST excavation bottom
Vertical Exageration 0 2
Horizontal Scale 1 48
Vertical Scale 1 240

= Diesel Fuel Isoconcentration Contour, dashed where inferred (mg/kg)

= Stratigraphic Contour ? = uncertain

Figure 2-2
Geologic Cross Section Showing
Diesel Fuel Concentrations in Soil (mg/kg)
Former UST Site 273B
CDM

What is SVE?

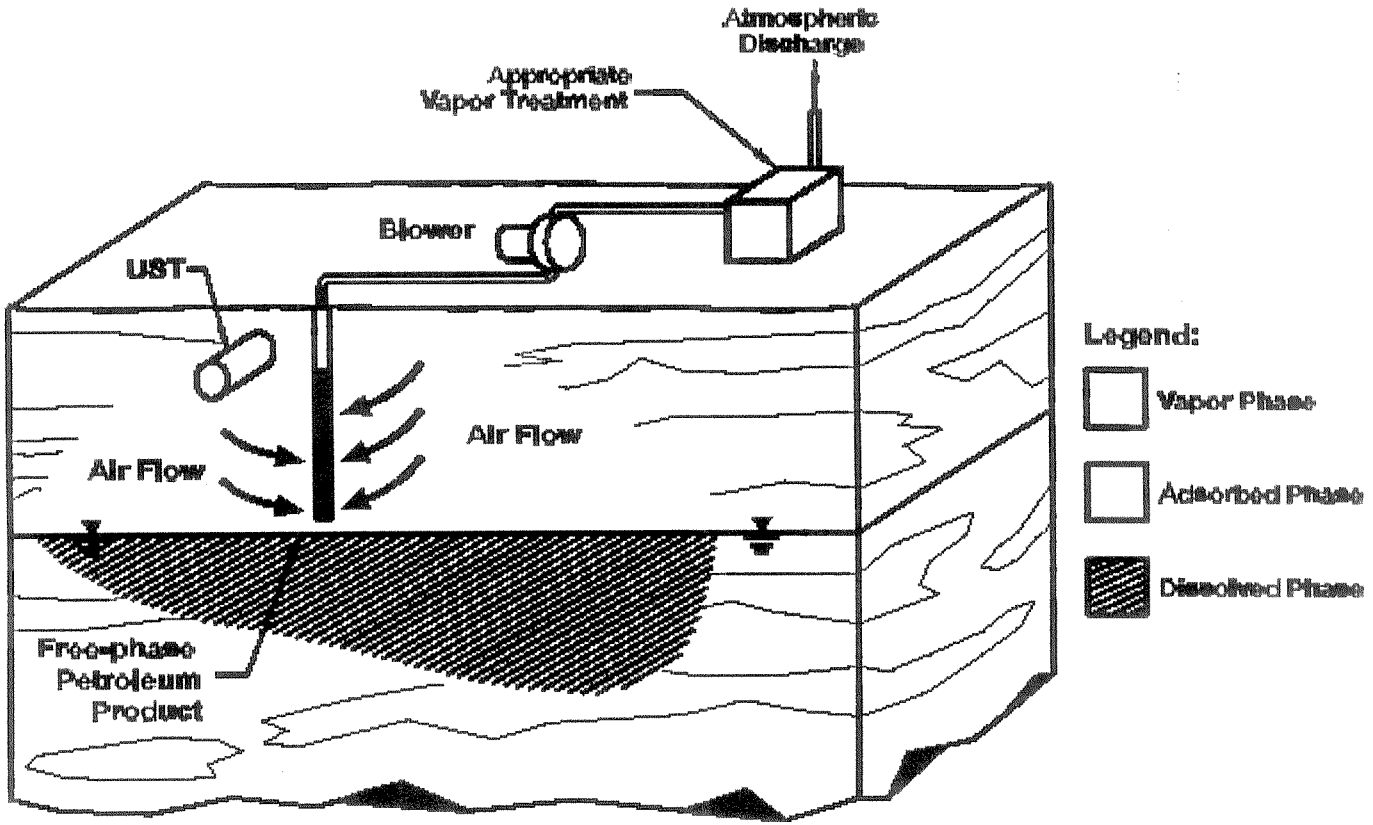
- SVE refers to soil vapor extraction and is one of the most widely used soil treatment technologies at CERCLA and RCRA sites.
- The U.S. Environmental Protection Agency (EPA) has identified SVE as a preferred approach (i.e., presumptive remedy) for remediation of volatile organic compounds (VOCs).
- VOCs are a group of chemical compounds composed of hydrogen and carbon that are characterized by their tendency to volatilize or partition from water or soil to air.

What is SVE?

- SVE systems are designed to remove chemicals that have a tendency to volatilize or evaporate easily by applying a vacuum through a system of underground wells.
- VOCs are pulled from the subsurface soils in vapor form and treated before discharging to the atmosphere
- Simplified diagram of SVE presented in following figure.

Simplified SVE System

Exhibit II-1
Typical SVE System



Advantages and Disadvantages

Exhibit II-2
Advantages And Disadvantages Of SVE

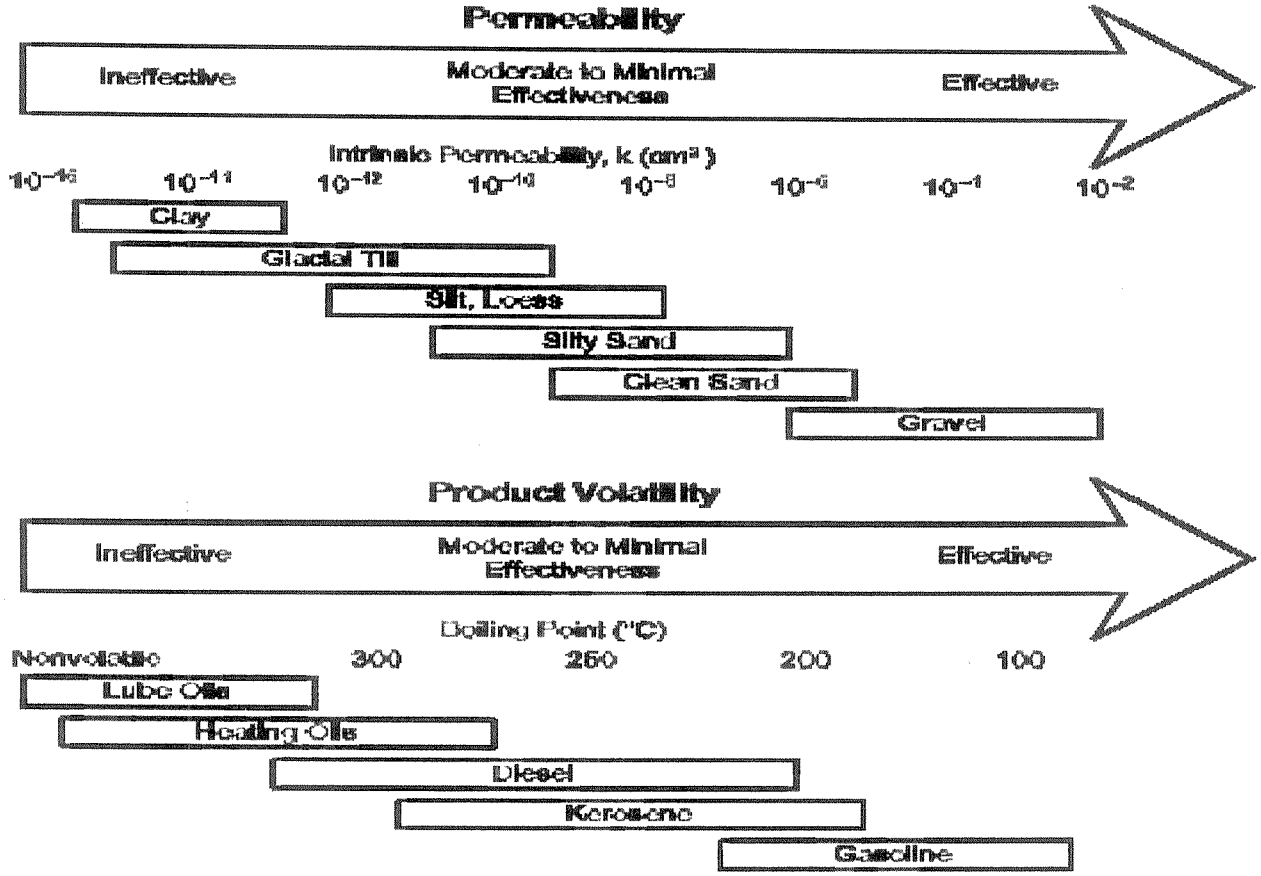
Advantages	Disadvantages
❍ Proven performance; readily available equipment; easy installation.	❍ Concentration reductions greater than about 90% are difficult to achieve.
❍ Minimal disturbance to site operations.	❍ Effectiveness less certain when applied to sites with low-permeability soil or stratified soils.
❍ Short treatment times: usually 6 months to 2 years under optimal conditions.	❍ May require costly treatment for atmospheric discharge of extracted vapors.
❍ Cost competitive: $20-50/ton of contaminated soil.	❍ Air emission permits generally required.
❍ Easily combined with other technologies (e.g., air sparging, bioremediation, and vacuum-enhanced dual-phase extraction).	❍ Only treats unsaturated-zone soils; other methods may also be needed to treat saturated-zone soils and groundwater.
❍ Can be used under buildings and other locations that cannot be excavated.	

SVE System Effectiveness

- SVE is an effective remedial option at sites impacted by solvents and other volatile compounds.
- The effectiveness of an SVE system at a given site depends on the properties of the soil and the properties and distribution of the chemicals in the subsurface.
- SVE is best suited to sites with permeable soil such as sand.

SVE System Effectiveness

Exhibit II-4
Initial Screening For SVE Effectiveness



Key Points for Successful SVE Implementation

- Delineation of soil contamination.
- Evaluation of soil conditions and physical properties.
- Placement of soil vapor extraction wells and monitoring points.
- Select appropriate SVE unit for soil conditions and contamination.
- Remove contaminants from vapor stream.
- Optimizing the SVE system after startup.
- Collect sufficient monitoring data to evaluate the effectiveness of SVE.